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USER'S MANUAL

Mine Air Monitoring

MDO-01

Documentation number: 210 18

This manual comprises the following:

Instructions for assembly and installation, commissioning, use, operation, settings, maintenance, service, disassembly, disposal and technical conditions

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User's Manual

This User's Manual comprises the instructions for assembly, installation, commissioning, use, operation, settings, maintenance and service, disassembly, disposal and technical conditions.

Any personnel performing the installation, commissioning, use, operation, maintenance and service must be made duly familiar with this User's Manual. Keep this manual for further use.

Use....2
Description and Functions....2
Assembly and Installation....3
Operation Instructions....4
Maintenance....4
Repairs and Spare Parts....4
Delivery, Transport and Storage....4
Fire Safety, Ecology, Disposal, Recycling....5
Manufacturer and Service Organisation....5
Relevant Standards, Regulations, Documents....5
Technical Parameters....5
Description of Components in RM1-CH4....7

Use

- The mine air monitoring system, MDO-01, has been designed for environment with the risk of explosion of gas fiery mines, to monitor the presence O_2, CO or CH_4 within mine atmosphere.
- The RM1-CH4 distribution unit or PC are not designed for environment within fiery mines atmosphere.
- The sensor types (I M1 Ex ia I) are suitable for utilisation in explosion hazard environment of fiery mines.

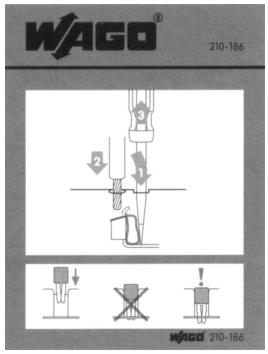
Description and Functions

- The MDO-01 comprises of the RM1-CH4 distribution unit, PC and sensors.
- The sensors are linked to the k RM1-CH4 via the metallic link. The RM1-CH4 is linked to the PC using an Ethernet cable provided with RJ45 connectors.
- The RM1-CH4 also contains the power supply part, the control and separating parts. The power supply unit comprises the input power feed protection and voltage adjustment for the separating and control parts respectively. The control unit is made of an automatic control feature and the separating unit comprises of spark-safety converters type MM5041.
- The control unit uses the separating unit to monitor the sensors for measuring of concentration of gases and the results gained are further forwarded to the master system – PC software.
- The supply of power into the RM1-CH4 is conducted using the X20 terminal board built with WAGO 281-691 and 281-607 screw-less terminals. The power source used must be compliant with the TN-S 230V/50Hz network.
- Backup power supply to the PC with master SW is provided with the Z2 socket or the X22 terminal board built with WAGO 281-691 and 281-607 screw-less terminals.
- The spark-safety terminal boards are fitted with WAGO 281-691 screw-less terminals. The X1 terminal board is used for connection of the sensor for CH_4, the X2 terminal board is used for connection of the sensor for CO, the X3 terminal board is used for connection of the sensor for O_2 and the X4 and X5 terminal boards are used for backup.

- The backup power supply for the control and separating units, as well as the PC, is provided by means of an uninterrupted power supply unit.
- The voltage from power supply runs through the double pole circuit-breaker F1 (16A/B) via the surge guard FV1 and backup-less socket Z1 intended for the purposes of service works on the backup power supply U1. The backup power supply unit U1 supplies the socket Z2 to power the PC and the circuit-breaker F2 (6A/C) for protection of the power supply unit GU1 (230VAC/24VDC).The GU1 output provides power for AT1, U2 – U7, KA1 a 2, HA1.
- To activate the distribution unit for operation purposes, switch on both circuit-breakers F1 and F2, activate the power supply unit GU1 (its indication LED will light up) and switch the control PLC on (indicated by glowing display) and JB converters (the indication LEDs will light up as well).
- Before working on the RM1-CH4 distribution unit, the unit shall be either switched off on both circuit-breakers F1 and F2 (the entire distribution unit must be switched off), or, if there is a need for supply voltage of 230V/50Hz, keep the circuit-breaker F1 switched on and switch off the circuit-breaker F2 only (both the control and separating units are off) – the Z1 and Z2 sockets will stay live in such case (Z2 is live using the backup power supply unit).
- Shutdown– to achieve a complete shutdown of the RM1-CH4 distribution unit, switch off both circuit-breakers - F1 and F2.

Assembly and Installation

- The RM1-CH4 has been designed for mounted installation on a wall or any other firm vertical surface using four screws with diameter of 6mm (according to the M6 standard or an expansion bolt sized 6mm with an adequate socket).
- Sensors for CH_4, CO and O_2 have been designed for mounted installation on a wall or any other firm vertical surface. Every sensor is fitted using 4 screws sized M5.
- The cabling is run out of the RM1-CH4 distribution unit using the "brush" to prevent influx of dust and dirt particles inside the distribution unit in the cabling vicinity.
- Cabling connected to sensors are led through the bushing (part of sensors) up to the screw-less or screw terminals. Once the cable has been connected to the terminal board of particular sensors, the bushing shall be tightened properly. Once, connected, the sensor bodies need to be re-assembled again (to eliminate any leaks etc.).
- None of the conductor ends may be set free.
- Any screws and bolts on devices, terminals, inside the box, must be tightened properly. Even those that are not in use.
- Conductor stripping length for terminal connection:
    - WAGO 281-691
        - connecting conductors intersection between 0,2mm^2 and 4mm^2.
        - conductor stripping length between 9mm and 10mm.
        - tool needed to open the terminal: bladed screwdriver sized 3,5mm x 0,5mm



Terminal 281

Operation Instructions

- Activation of MDO-01: To activate the system, switch on both circuit-breakers F1 and F2 in the RM1-CH4 distribution unit. That will enable the supply of power to the PC as well as the control PLC, the JB on separating unit and sensors.
- The F1 circuit-breaker is the main one – it switches the entire power supply on/off. The F2 circuit-breaker serves to switch on/off the control PLC, the JB of separating unit and sensors only.
- The HA1 alarm sounds in case of communication loss between the control PLC and PC for a period of time exceeding 15 minutes.
- Installation and operation of SW on PC – see appendices.
- Operation and calibration of the sensor for O_2 (MTA4332.15) – see appendices.
- Operation and calibration of the sensor for CO (MTA4322.15) – see appendices.
- Operation and calibration of the sensor for CH_4 (SC-CH4) – see appendices.

Maintenance

- Use a piece of dry cloth or broom to remove any dust or dirt particles from the surface, further cleaning of the surface shall be conducted using a piece of cloth soaked with water and regular cleaning agents or alcohol based agents.

Repairs and Spare Parts

- Any repairs and spare parts shall be the responsibility of the manufacturer.

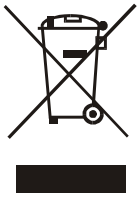
Delivery, Transport and Storage

- Order code:
    - quantity of RM1-CH4 units
    - quantity of sensors for CH_4
    - quantity of sensors for CO
    - quantity of sensors for O_2
    - distance between RM1-CH4 and the sensor for CH_4
    - distance between RM1-CH4 and the sensor for CO
    - distance between RM1-CH4 and the sensor for O_2

- The deliver includes:
- This User's Manual.
    - The Certificate of Conformity.
    - The Product Quality and Completeness Certificate.
    - The product itself.
- Any spare parts are supplied loose.
- Any parts shall be transported with the minimum of jolts or knocks. The parts shall be stored in dry place with the ambient temperature between 0 and 40 ^{o}C in a single layer.

Fire Safety, Ecology, Disposal, Recycling

- Do not expose to open fire, combustion produces harmful substances.
- Proper operation has no adverse impact on the environment and ecology.
- Once the product life has expired, return the product back to the manufacturer responsible for safe disposal. See the address listed herein.



- No electric or electronic equipment past its life may be disposed of with regular municipal waste. The product shall be deposited at an official collection point to ensure its correct processing, refurbishment and recycling of electric and electronic parts.
- For detailed information about the waste collection point please approach local authorities, your local enterprise concerned with liquidation of municipal waste or at the distributor, where the products has been purchased.

Manufacturer and Service Organisation

ZAM - SERVIS s.r.o. Křišťanova 1116/14, 702 00 Ostrava - Přívoz, Phone: 596 135 422 e-mail: zam@zam.cz

Relevant Standards, Regulations, Documents

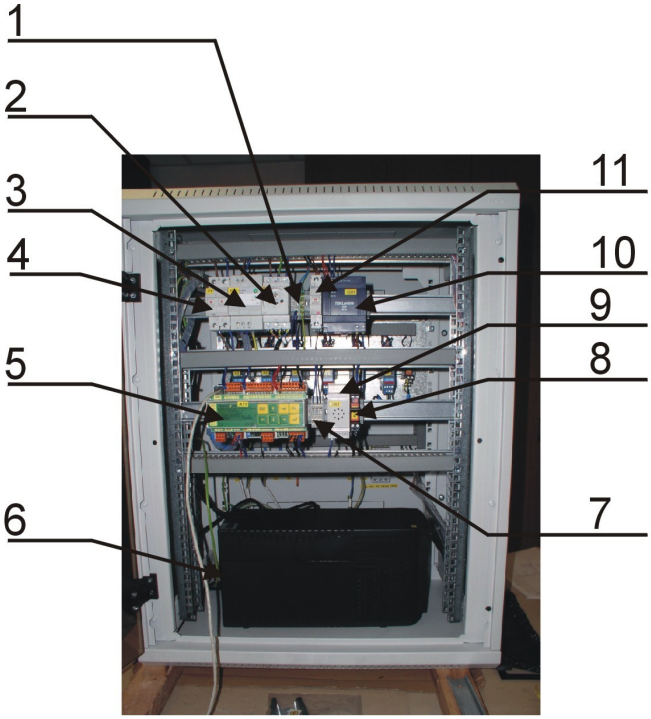
- ČSN EN 33200-4.41 Electrical Accidents Protection.
- ČSN EN 60439-1 L.V. Distribution Units.
- ČSN EN 60079-0 General Requirements.
- ČSN EN 60079-10 Electric Devices for Fiery Atmosphere with Explosion Hazard: Definition of Hazardous Areas
- ČSN EN 60079-11 Atmosphere with Explosion Hazard: Device Protection with Spark Safety "i"
- ČSN EN 60079-25 Electric Devices for Fiery Atmosphere with Explosion Hazard: Spark-Safe Systems
- ČSN EN 1127-1 Environments with Explosion Hazard – Prevention and Protection from Explosions: Essential Terms and Methodology
- ČSN EN 1127-2 Environments with Explosion Hazard - Prevention and Protection from Explosions: Essential Concept and Methodology for Mines
- ČSN EN 50303 Presence of Methane and/or Combustible Dust.

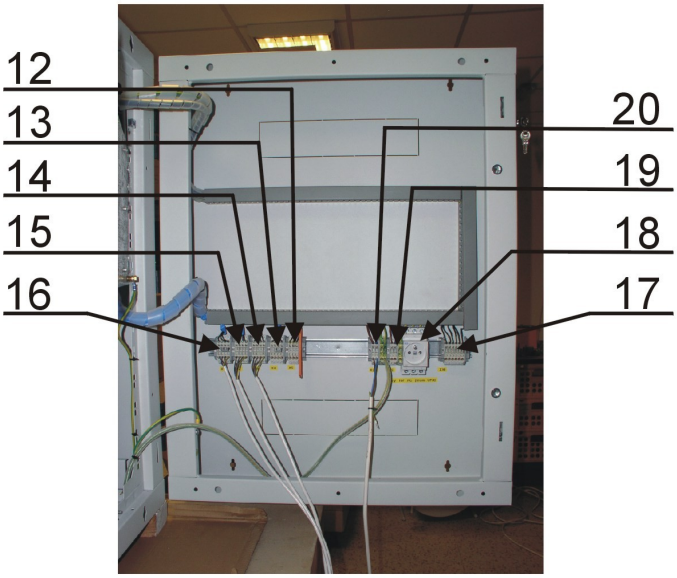
Technical Parameters

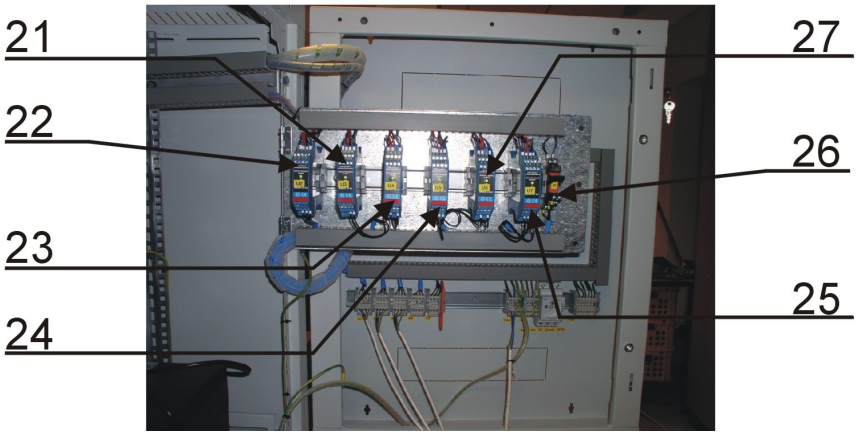
Nominal supply voltage	230VAC
Max. supply current	16A
JB converter MM5041	
U_O	21.42 V
I_O	147 mA
P_O	0.787 W
C_O/L_O	125 uF/4,1uH
U_I	21.42 V

I_I	147 mA
P_I	0.787 W
C_I/L_I	0/0
SC-CH4 sensor	
U_O	7.9 V
I_O	80 mA
U_I	30 V (I, IIA, IIB) 22 V (IIC)
P_I	3 W (I) 1,25 W (II)
C_I	0
L_I	200 uH
O2 sensor type MTA4332.15, CO sensor type MTA4322.15	
U_O	
I_O	6.6 V
U_I	141 mA
I_I	22 V
P_I	280 mA
C_I	3.3 W
L_I	0 nF
	0 uH
1x change-over contact JB	8A/250VAC
2x change-over contact	8A/250VAC
Connecting conductors intersection	
output	0.2 to 4 mm^2
input	0.2 to 4 mm^2
Protection of RM1-CH4	IP 30
SC-CH4 sensor protection	IP 54
O2 (MTA4332.15) sensor protection	IP 65
CO (MTA4322.15) sensor protection	IP 65
Temperature range	0 to 40 °C
Size of RM1-CH4	600x770x535 mm
Size of SC-CH4 sensor	85x145x75 mm
Size of O2 (MTA4332.15) sensor	180x145x80 mm
Size of CO (MTA4322.15) sensor	180x145x80 mm
Weight of electronic accessories in RM1-CH4	
Weight of distribution unit in RM1-CH4	28.7 kg
Weight of SC-CH4 sensor	600 g
Weight of O2 (MTA4332.15) sensor	450 g
Weight of CO (MTA4322.15) sensor	450 g
Relative humidity	95% condensation free
Sensor models	I M1 Ex ia I
Fuses	
F1	1P/16A/B circuit-breaker
F2	1P/6A/C circuit-breaker

Description of Components in RM1-CH4







Components according to picture numbering:

1. X21 – terminal board to lead the voltage from the output from the backup power supply unit U1
2. Z1 – 230V/50Hz/16A socket connected before the backup power supply unit. For service purposes only.
3. FV1 – Level II surge protection. Device protection from ELMG wave.
4. F1 – Double pole circuit-breaker 16A, B characteristic. Supply excess current protection that also serves as the main switch for the RM1 distribution unit.
5. AT1 – Control PLC. It is used for monitoring of sensor status and forwarding the data measures to the master system – PC.
6. U1 – Backup power supply unit.
7. X11 – Terminal board for connection of the Ni1000 temperature sensor.
8. KA2 – Electromagnetic relay. Its two switching contacts are located on the terminal board X10. For service purposes.
9. HA1 – Alarm to indicate the failure of communication between AT1 and PC for the period of time exceeding 15 minutes.
10. GU1 –230VAC/24VDC power supply unit for PLC, converters, relay and alarm.
11. F2 – Single pole circuit-breaker 6A, C characteristic. Excess current protection of the GU1 power supply unit functioning as the switch for the GU1 power supply unit.
12. X5 – Spark-safe terminal board with the relay switching contact KA1.
13. X4 – Spark-safe terminal board for potential sensor connection. Backup.
14. X3 – Spark-safe terminal board for connection of the O_2 sensor – MTA4332.15.
15. X2 – Spark-safe terminal board for connection of the CO sensor – MTA4322.15.
16. X1 – Spark-safe terminal board for connection of the CH_4 sensor– SC-CH4.
17. X10 – Terminal board with two switching contacts for the KA2 relay.
18. Z2 – 230V socket with backup for connection of the PC.
19. X22 – Terminal board with power supply with backup for PC.
20. X20 – Input terminal board for power supply to the distribution unit. 230V/50Hz.
21. U3 – JB signal separation for CO sensor – MTA4322.15.
22. U2 – JB signal and power supply separation for CH_4 sensor– SC-CH4.
23. U4 – JB power supply separation for CO sensor– MTA4322.15.
24. U5 – JB signal separation for O_2 sensor – MTA4332.15.
25. U7 – JB power supply and signal separation for sensor. Backup.
26. KA1 – Relay with a switching contact ready for use in JB circuits.
27. U6 – JB power supply separation for O_2 sensor – MTA4332.15.